

Atty. Docket No. 2001-0065-01
USSN 09/491,969

Amendments to the Specification:

Please amend the specification as follows:

On page 13, please replace the first paragraph with the following amended paragraph:

actuator aspect does not generally contemplate soft polymer piezoelectric materials. While the terms "stiff" and "soft" are relative, it will be understood that in this context, the stiffness, as applied to an actuator, is approximately that of a metal, cured epoxy, high-tech composite, or other stiff material, with a Young's modulus greater than 1×10^6 psi, and preferably greater than 2×10^6 psi. When constructing sensors, instead of actuators, the invention also contemplates the use of low-stiffness piezoelectric materials, such as polyvinylidene difluoride (PVDF) film and the substitution of lower cure temperature bonding or adhesive materials. The principal construction challenges, however, arise with the first class of piezo material noted above, and these will now be described.

On page 16, please replace the first paragraph with the following amended paragraph:

FIGURE 2A is a somewhat schematic view, inasmuch as it does not show the layer structure of the device which secures it together, including a further semi-transparent top layer 116-110 (FIGURE 2B), which in practice extends over the plate 112 and together with the spacers 120 and sheet 110 closes the assembly. A similar layer 114 is placed under the piezo element, with suitable cut-outs to allow the electrodes 111 to contact the element. Layers 114, 116 are preferably formed of a curable epoxy sheet material, which has a cured thickness equal to the thickness of the metal electrode layer, and which acts as an adhesive layer to join together the material contacting it on each side. When cured, this epoxy constitutes the structural body of the device, and stiffens the assembly, extending entirely over a substantial portion of the surface of the piezo element to strengthen the element and arrest crack growth, thereby enhancing its longevity. Furthermore, epoxy from this layer actually spreads in microscopically thin

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but highly discontinuous film 116, about .0025 mm thick, over the electrodes, bonding them firmly to the piezo plate, but with a sufficient number of voids and pinholes so that direct electrical contact between the electrodes and piezo elements still occurs over a substantial and distributed contact area.

On page 17, please replace the second paragraph with the following amended paragraph:

A preferred method of manufacture involves applying pressure to the entire package as the layer 116-114 cures. The spacers 120 serve to align the piezoceramic plates and any circuit elements, as described below with reference to FIGURES 3-5, and they form a frame that is compressed slightly during assembly in the cure step, at which time it may deform to seal the edges without leaving any stress or irregularities. Compression eliminates voids and provides a dense and crack-free solid medium, while the curing heat effects a high degree of cross-linking, resulting in high strength and stiffness.